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ABSTRACT

This document summarizes data from the National Science Foundation (NSF) report on An Analysis of Federal Research and Development Funding by Function, Fiscal Years 1969-1978. Highlights include: (1) 1978 expenditures are estimated at $26.3 billion, a 7.6% increase over 1977; (2) funding between 1974 and 1978 represents an increase of 3.4% in constant dollars; (3) most expenditures have been in the areas of defense and energy; and (4) expenditures in energy for 1978 are estimated to grow 17% over 1977. (SL)

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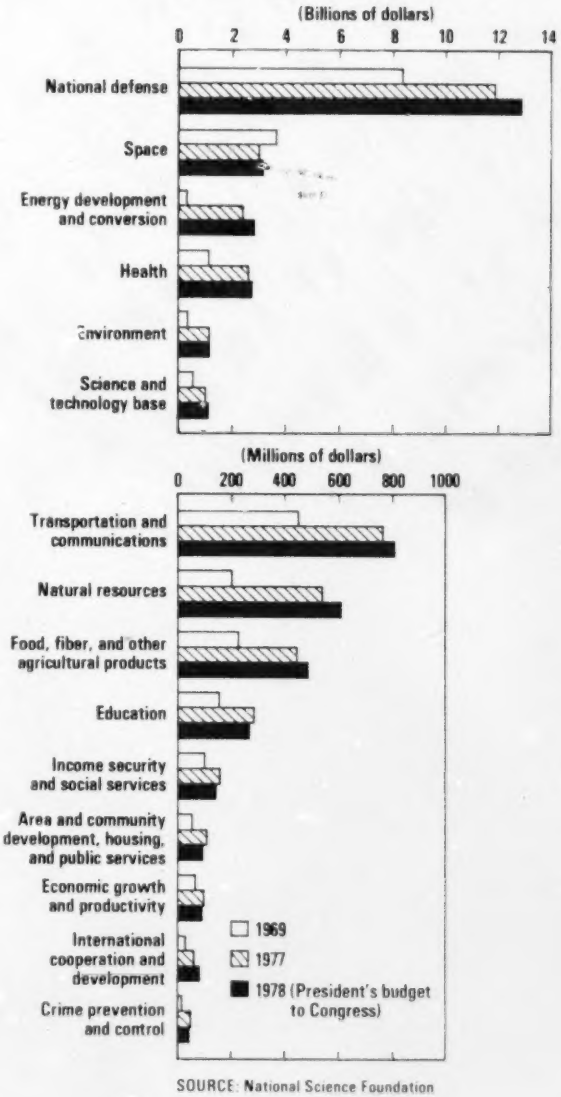
Defense and Energy Spur Federal R&D Growth From FY 1974 to FY 1978

Data discussed below are taken from a forthcoming report, An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1978. *The 15 functional categories were chosen to make visible the chief objectives reflected by R&D programs in the 1978 budget. Data are additive to 100 percent, and thus each program can appear only under the function that embraces its primary purpose and not under functions that relate to secondary purposes.*

- In fiscal year 1978 Federal R&D obligations will amount to an estimated $26.3 billion, a figure 7.6 percent above 1977 but only a slight increase in real terms, assuming a 6-percent rate of inflation.
- Federal R&D funding grew so slightly between 1969[1] and 1974 that it represented a decline in real terms, but between 1974 and 1978 the annual average growth rate is 10.9 percent, or an increase of 3.4 percent in constant dollars.
- Between 1974 and 1978 most of the expansion (92 percent) has been generated by gains in six leading functional areas, especially those of defense and energy.
- In 1978 energy development and conversion is expected to grow by 17 percent over 1977, more than any major function. Science and technology base will increase an estimated 11 percent, and defense, an estimated 8 percent. Each of these functions probably will show a gain in real performance, assuming a 6-percent inflation rate for the whole economy.
- The other three leading functions—space, health, and environment—all will probably reflect declines in the real level of effort.
- Of the next three largest R&D functions transportation and communications is also scheduled for an apparent 1978 decline in real terms, whereas natural resources and food, fiber, and other agricultural products appear to be scheduled for real increases following a recent period of significant growth.

Federal R&D obligations by function, FY 1969, 1977 (est.) and 1978 (est.)



SOURCE: National Science Foundation

[1] Data on R&D funding by function are available for prior years only back to 1969. Accurate detail for earlier years is not available.

(Prepared in the Government Studies Group, Division of Sciences Resources Studies)

SE 023 187

- Between 1969 and 1978 an outstanding feature of Federal R&D support has been the sharp rise in emphasis on civilian R&D programs as compared with defense and space. In recent years, however, defense funding has grown, especially after 1974, and although space programs declined from 1969 to 1974, a moderate rise has been recorded in the years since then.

Factors in Funding Changes

From 1974 to 1978 an estimated $8.9 billion has been added to the Federal R&D total, and most of the impetus to growth has come from national defense and energy, which account, respectively, for 44 percent and 25 percent of the total gain. In the 1972 budget, administration policy was focused on higher defense spending, following a 3-year period of no growth. This policy was subsequently reflected in defense totals, especially after 1974. The effect on defense R&D efforts was somewhat delayed; after significant growth in 1972, R&D support did not rise importantly until 1975 but has continued in a positive upward trend since then.

Growing concern about a national shortage of energy was heightened by the Arab oil embargo in the fall of 1973. The Federal response was to increase energy R&D programs sharply. Between 1974 and 1978 R&D funding for energy increased more than 4½ times, far more than for any other function. The energy function is now the third most heavily funded area after national defense and space.

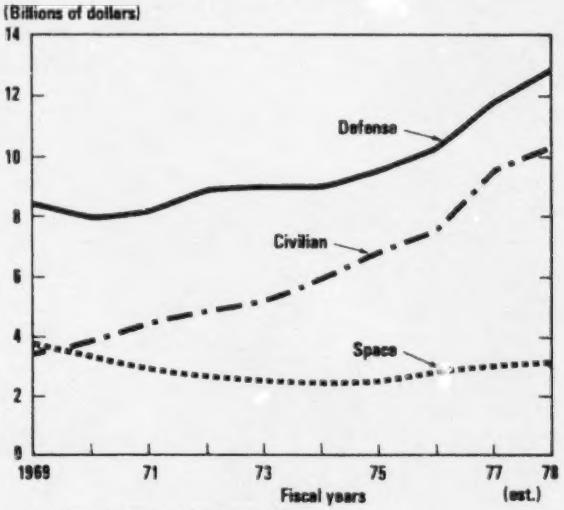
In the same period, 1974-78, funding for space has contributed 7 percent of the increase in Federal R&D obligations. With the phasing out of the Apollo program by 1973, the space shuttle became the chief focus of space support. Not until 1975, however, did the increases in funding for the space shuttle produce a rise in obligations for the total space function, a rise that has continued each year since that time. Even so, funding in 1978 is lower than in 1969.

Health has also accounted for 7 percent of the 1974-78 Federal R&D gain. A Presidential policy decision in 1972 added impetus to growing support to cancer research, which continued to rise every year thereafter. Additional emphasis was placed on heart and lung research in 1974 with increases in most subsequent years. More recently other areas of biomedical research have gained importantly: arthritis; metabolism and digestive diseases; allergy and infectious diseases; general medical sciences; child health and human development; and environmental health sciences.

Environmental R&D support in the 1974-78 period, which makes up 5 percent of the overall Federal growth, covers a large number of program areas. The most notable of these are energy-related programs, a group of environmental data and monitoring programs, and programs in occupational safety and health. Recent emphasis is on earthquake engineering and prediction.

Funding for science and technology base has risen significantly in the 1974-78 period and accounts for 4 percent of the increase. Chief gains for this function have been shown by high-energy physics and by research project support for a number of science disciplines. The 1978 rise reflects a Presidential policy decision to support basic research at a level 3 percent ahead of inflation.

Trends in Federal obligations for defense, space, and civilian R&D programs: FY 1969-78



SOURCE: National Science Foundation

Other functional areas that have contributed to overall Federal R&D growth in the 1974-78 period are natural resources, 3 percent of the total; food, fiber, and other agricultural products, 2 percent; and transportation and communications, 1 percent.

R&D Programs by Function

- Growth for **national defense** in 1978 is strong, accounting for more than one-half the Federal R&D dollar gain over 1977. Defense has also accounted for approximately one-half of all Federal R&D support in the 1969-78 period. The share of this function, however, has dropped since 1972 when it reached a high of 54 percent; the estimated share in 1978 is 49 percent.

The leading area, *tactical programs*, accounts for one-third of all defense R&D support in 1978. This area is scheduled to grow by 17 percent in the current budget to a level of $4.4 billion. In air warfare systems, work will go forward on the Air Force F-16 and Navy F-18 fighter aircraft and accompanying air-to-air missiles. Development will continue on V/STOL (vertical short takeoff and landing) technology. In land warfare, major developments include the Army XM-1 tank, the Advanced Attack Helicopter (AAH), and the Patriot (SAM-D) air defense system. In ocean control, the major development effort is the LAMPS antisubmarine warfare helicopter.

Strategic programs are next in size, and these are scheduled to total $2.3 billion in 1978, the same level as the previous year. A major development effort is planned for the Navy Trident sea-launched ballistic missile system.

Federal R&D obligations by function:[1] fiscal years 1969-78

[Dollars in millions]

Function	1969	1970	1971	1972	1973	1974	1975	1976	Estimated 1977	Estimated 1978
Total	$15,641	$15,340	$15,545	$16,498	$16,800	$17,415	$19,013	$20,759	$24,465	$26,317
National Defense	8,354	7,976	8,106	8,898	8,998	8,975	9,621	10,346	11,917	12,907
Space	3,732	3,510	2,893	2,714	2,601	2,478	2,511	2,863	2,972	3,140
Energy development and conversion[2]	328	317	324	383	442	605	1,110	1,388	2,390	2,798
Health	1,127	1,126	1,338	1,589	1,624	2,096	2,177	2,366	2,622	2,683
Environment	315	354	465	533	651	693	837	899	1,101	1,098
Science and technology base	513	525	524	603	605	695	782	839	953	1,060
Transportation and communications	458	590	779	615	630	703	641	636	769	805
Natural resources	201	238	326	354	341	341	445	489	547	610
Food, fiber, and other agricultural products	225	241	247	291	297	291	349	388	444	488
Education	155	147	186	191	214	173	149	142	284	269
Income security and social services	97	106	128	125	157	134	148	133	156	148
Area and community development, housing, and public services	49	91	89	87	97	96	102	104	111	99
Economic growth and productivity	56	80	99	63	75	72	67	86	98	97
International cooperation and development	27	32	32	29	33	27	30	45	53	71
Crime prevention and control	5	9	10	25	35	36	46	36	49	44

[1] R&D plant excluded.

[2] The inclusion of R&D plant obligations for energy would add $267 million in 1976, $509 million in 1977, and $552 million in 1978.

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Science Foundation.

Another is planned for the Air Force B-1 bomber (procurement of which has been discontinued by the President while development goes forward). Full-scale development will begin on the Air Force M-X intercontinental ballistic missile. Two cruise missiles—one Navy, one Army—will continue in full-scale development.

Technology base reflects planned growth of 10 percent to the $1.9 billion level in 1978. This is in line with a DOD policy initiated in the 1976 budget to reverse a real long-term decline.

Intelligence and communications is scheduled for an 11-percent rise to $1.2 billion to cover improvements in capabilities in this area.

Advanced technology development will show an estimated 6-percent increase.

Defense-related atomic energy programs, entirely conducted by ERDA, are scheduled to increase 7 percent in 1978.

• In 1978 the increase in funds directed to **space** is not great enough to reverse the downward trend in the share of this function in the Federal R&D total. In 1969 the share was 24 percent, but in 1978 it is an estimated 12 percent. Space is the only function to show lower funding in 1978 than in 1969.

The largest program is the NASA space shuttle, on which development will continue. Another program within *manned space flight* is space transportation system (STS) operations capability development scheduled for a fivefold increase in 1978. Under *space sciences* large relative increases are planned for physics and astronomy, including the start of development by NASA of a 2.4-meter space telescope. A Jupiter orbiter/probe will also be initiated in 1978.

• Gains in **energy development and conversion** have been unprecedentedly high for a major function ever since 1974. From 1969-74 the average annual growth rate for this function was 13.0 percent; from 1974-78 an estimated 47 percent. In 1978 the dollar gain will account for more than one-fifth of the total Federal R&D dollar increase. As a share of Federal R&D programs those in energy have grown from 2 percent in 1969 to an estimated 11 percent in 1978.

In 1978 *nuclear* programs make up more than one-half of the energy total. As a group they are scheduled for a 15-percent increase. Among them considerable growth is shown for ERDA fuel cycle R&D, NRC reactor safety research, and ERDA laser and magnetic fusion programs, but obligations for the ERDA liquid metal fast breeder reactor are down.

Nonnuclear programs as a whole reflect a 19-percent increase. Among these *fossil* energy shows no growth because of lower emphasis on the ERDA coal utilization program, but ERDA *solar* energy development shows a rise of 9 percent and ERDA *geothermal* energy development a rise of 60 percent. *Conservation* programs are scheduled for an 88-percent increase. Chief among these is work by ERDA on end-use conservation.

• In 1978 the growth for **health** R&D programs is so slight (2 percent) as to reflect a decline in the real level of effort. Obligations for 1977 were high because of the effects of a congressional override of the President's veto of the 1976 HEW appropriation midway in the fiscal year; this caused an increase in obligations that continued into fiscal year 1977. Over the longer term, funds in the health area have grown substantially; the average annual growth rate from 1969-78 is 10.1 percent compared with 6.0 percent for all Federal R&D programs. The share of health in the total has risen from 7 percent in 1969 to an estimated 10 percent in 1978.

Biomedical research accounts for 9 out of 10 health dollars. A gain of 3 percent is shown for this subfunction.

Most work is carried out by the National Institutes of Health (HEW). Institute programs showing real growth in 1978 are general medical sciences, allergy and infectious diseases, aging, and environmental health sciences.

• **Environment** reveals a slight decrease in 1978 as a total area. Until 1978, however, this function has shown very strong growth between 1969-74 an average annual growth rate of 17.1 percent and between 1974-78 a comparable rate of 12.2 percent. The share of environment in the Federal R&D total is 4 percent in 1978 against 2 percent in 1969.

Environmental health and safety is sheduled for a 5-percent rise, chiefly influenced by ERDA's environmental R&D efforts. *Pollution control and environmental protection* will receive a decrease (of 9 percent) for the first time, largely resulting from declines in EPA water quality and energy-related environmental control programs, which were not offset by a large increase in ERDA nuclear materials security efforts. A 4-percent rise in *understanding, describing, and predicting the environment* is influenced by the large expansion of Interior mapping of earthquake geologic hazards and NSF earthquake engineering programs.

• **Science and technology base** maintained fairly level funding until 1974 when significant increases began to be shown. In 1978 the rise is an estimated 11 percent. From 1969-74 average annual growth of 6.2 percent was recorded; from 1974-78, the growth is 11.1 percent. The share within the Federal R&D total has grown from 3 percent in 1969 to 4 percent in 1978.

The largest individual programs within this function—high-energy physics (ERDA) and basic energy sciences (ERDA)—both reflect substantial increases in 1978 as do a number of research support programs of NSF, notably those in materials, physiology, cellular and molecular biology, and behavioral and neural sciences.

• **Transportation and communications** is expected to gain by 5 percent in 1978, a decline in real performance overall. This function has grown during the 1969-78 period at 6.5 percent on an average annual basis about the same rate as Federal R&D obligations as a whole. A 3-percent share of total was shown in 1969, the same as is estimated for 1978.

• **Natural resources** is scheduled for 12-percent growth in 1978. This function has shown such important gains over the long-term (1969-78) period that the average annual growth rate is 13.1 percent, more than twice that of total Federal R&D funding. The share of natural resources within the Federal R&D total in 1978 is an estimated 2 percent.

• The **food, fiber, and other agricultural products** function grew slowly between 1969 and 1974 but much more rapidly thereafter, an average annual growth rate of 5.3 percent for the earlier period compared with 13.8 percent in 1974-78. The share of this function in the Federal R&D total in 1978 is 2 percent.

The 10-percent rise in the food function in 1978 is mainly directed to research by USDA on animal and plant production, including the initiation of a 5-year program of competitive research grants.

• Six functions—*education; income security and social services; area and community development, housing, and public services; economic growth and productivity; international cooperation and development;* and *crime prevention and control*—together will account for an estimated 2.9 percent of all Federal R&D obligations in 1978.

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